VEGETATION STUDIES ON THE HUMBOLDT MOUNTAINS FIORDLAND PART 2: THE LICHENS

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SUMMARY

A detailed list is given of the species of macrolichens collected from the western slopes of the Humboldt Mountains, Fiordland. The composition and possible importance is discussed of "sub-regional" lichen communities.

INTRODUCTION

The lichen flora of New Zealand is still imperfectly known and details of its regional composition are lacking for much of the country. A survey of the rather scattered literature reveals that very little taxonomic or ecological work has been done on the alpine lichens. The great difficulty in field lichenology is accurate recognition of species, particularly in alpine regions, where crustaceous lichens, many yet unknown or undescribed, may be important, and even the sole elements, of the lichen flora. This paper records the major part of the lichen flora, with the exception of most of the microlichens, on the western slope of the Humboldt Mountains in Fiordland, and attempts to show distribution, abundance and habitat for each species.

Apart from occasional specimens, lichens were collected from three main localities:

1. The environs of Lake Mackenzie *c.* 800 m.
2. The basin in which the lake lies, from lake level to the head of Emily Pass *c.* 1,500 m.
3. The leading spur and summit ridges of Ocean Peak between 1,000 m. and 1,848 m. (Mark and Burrell 1966).

THE LICHEN FLORA

The Lake Mackenzie Area

Lake Mackenzie is surrounded along most of its shoreline by mature forest, dominated by *Nothofagus menziesii*. Lichens were collected from the surrounding forest, from the small peninsula at the south-western end of the lake, from open grassy sites around the lake edge and from exposed boulders near the outlet.

The commonest epiphytic foliose lichens in the beech forest are species of *Sticta*, some often reaching great size: *S. hirta*, *S. coronata*, *S. latifrons*, *S. filix*. The most common epiphytic fruticose lichens are species of *Usnea* and *Sphaerophorus*.

Usnea xanthopoga and *U. capillacea* are common on twigs of *Nothofagus* in well-lit situations either at the forest edge or at the top of the canopy. *Sphaerophorus tener* is a common epiphyte and other members of this genus represented in lesser numbers are several varieties of *S. melanocarpus* and occasionally *S. stereocauloides*. This, the largest species of the genus and the only one to have cephalodia, appears to be restricted to areas of high rainfall in west and south-west areas of the South Island. It grows only high up in the canopy and is often found on the ground among debris from high branches. Where light is sufficient small branches and twigs of *Nothofagus* are covered with an association of foliose and crustaceous corticolous lichens of which the most common are *Anzia angustata*, *Collema* spp., *Menegazzia pertransita*, *M. circumsorediata*, *Pertusaria nothofagi* and several species of *Psoroma*. The forest floor and the lower trunks of most forest trees are covered with a dense layer of bryophytes, with which few lichens seem able to compete, although *Sticta filix*, *Sphaerophorus tener* and several *Cladonia* species are common among mosses on the forest margin.

On large rocks around the lake edge lichens are often abundant above high water level, often forming complex associations including *Cladonia* spp., *Hypogymnia enteromorpha*, *Coccocarpia cronia*, *Sticta mougeotiana*, *Thamnolia vermicularis*, several *Psoromas* and various micro-lichens. After consolidation. principally by *Baeomyces heteromorphus*, *Placopsis parellina* and *P. trachyderma* var. *clavifera*, exposed screes and clay banks and faces between Lakes Howden and Mackenzie are colonized mainly by *Stereocaulon ramulosum* and *S. solensoi*.

The Basin Above Lake Mackenzie

The lower part of the basin draining from Emily Pass (between a buttress of Ocean Peak and Emily Peak) to Lake Mackenzie is covered with scrub of *Hebe subalpina* and *H. odora.* The commonest epiphytic foliose lichens are: *Coccocarpia cronia, C. gayana, Collema incisa, C. leucocarpon, Nephroma australe, N. helveticum* and several species of *Sticta. Haematomma babingtoni, H. puniceum* and *Lecanora atra* are common crustaceous lichens on twigs of *Discaria toumatou.* The rocky cirque below Emily Pass is poor in lichens and those present are mainly saxicolous and crustaceous, being almost restricted to the more stable rocks. *Placopsis* is represented by about four species of which *P. perrugosa* is the most common. *Parmelia (Melanoparmelia) adpicta* and *P. (M.) alpicola* are locally abundant on rocks. *Coenogonium nigrum* and *Lepraria incana* occur on the underside of large boulders in comparatively dry situations. The only fruticose lichen of any notable importance in this habitat is the small bullate *Stereocaulon caespitosum.* The lichen flora of Emily Pass is composed almost entirely of crustaceous species, mainly because of the exposed locality. *Rhizocarpon geographicum* agg. and species of *Lecidea* and *Pertusaria* are abundant.

Ocean Peak

The lichen flora on the leading spur of Ocean Peak is more varied and species more numerous than in the Lake Mackenzie basin. *Siphula medioxima* and *S. roccellaeformis* are common on the snow-tussock slopes between 1,000 m. and 1,800 m. although they are often replaced locally by *Hypogymnia lugubris* and several species of *Cladonia. Thamnolia vermicularis* is common and widespread in this locality but, surprisingly, *Cetraria islandica* appears absent. Dominant saxicolous species are *Placopsis perrugosa* and *P. parellina,* and *Stereocaulon caespitosum* is locally common on isolated boulders, together with *Rhizocarpon grande* and other crustaceous lichens.

Summit ridges above about 1,600 m. support a rich and varied flora. *Neuropogon ciliatus* is common on the rocks with lesser numbers of *N. acromelanus, Alectoria pubescens, Umbilicaria polyphylla* and *U. pustulata.* Species of *Placopsis* are very scarce at this high altitude. their place being taken by *Rhizocarpon geographicum* agg. and species of *Menegazzia, Melanoparmelia, Sticta, Pertusaria, Ochrolechia, Parmelia* and *Candelariella.* On soil between rocks, the main lichen is *Usnea contexta;* also present, though in lesser numbers, are *Thamnolia vermicularis, Hypogymnia lugubris, Pertusaria dactylina, Lecanora parmelina, Lopadium fuscoluteum* and species of *Siphula* and *Cladonia.*

The lichens collected from these three localities are listed in Table 1. The majority of records are supported by specimens housed in the Otago University Herbarium. The list of macro-lichens is believed to be fairly representative; the micro-lichens, however, are largely undetermined. The scheme of classification followed is that of Mattick (1954), with the slight modification that *Siphula* and *Thamnolia,* lacking perfect stages, have been transferred to the *Lichenes Imperfecti.**

TABLE 1. *A tentative list of lichens collected from three localities on the Humboldt Mountains. Locality, substrate, and abundance are given for each species as follows:—*

Abundance Scale	Substrate	Locality
r = rare	R = rock	1. Lake Mackenzie
o = occasional	S = soil	2. Lake Mackenzie basin
f = frequent	B = bark	3. Ocean Peak
a = abundant	M = among bryophytes	

	Locality		
LICHENES IMPERFECTI	1	2	3
Lepraria flava	B.r		
L. incana		R.o	
Siphula medioxima	S.r		S.f.
S. fragilis			S.f
S. mooreii			S.o
S. roccellaeformis			S.f
Thamnolia vermicularis	S.o	S.o.	S.f.
SERIES CONIOCARPINEAE			
Fam. Caliciaceae			
Calicium abietinum	B.r		
Fam. Cypheliaceae			
Cyphelium emergens	B.r		
Fam. Sphaerophoraeceae			
Sphaerophorus melanocarpus var. australis (Laur.) Murr.	B.f		
S. melanocarpus var. australis f. angustior (Reinke) Murr.	B.o		
S. melanocarpus var. australis f. insignis (Laur.) Murr.	B.o		
S. melanocarpus var. australis f. palmatus Murr.	B.o		

* Authorities for specimens quoted in Table I are given in Zahlbruckner (1927), unless otherwise stated.

S. melanocarpus var. scrobiculatus (Bab.) Murr.	B.o		
S. melanocarpus var. scrobiculatus f. macrophyllus (Zahlbr.) Murr.	B.o		
S. stereocauloides	B.o		
S. tener	B.M.a		
SERIES CYCLOCARPINEAE			
Fam. Lecanactidaceae	B.o		
Sagenidium molle			
Phlyctella neozelandica	B.o		
Fam. Thelotremaceae			
Thelotrema lepadinum	B.o		
Fam. Gyalectaceae			
Dimerella lutea	B.r		
Fam. Coenogoniaceae			
Coenogonium implexum	B.r		
C. nigrum		R.o	
Fam. Collemataceae			
Collema leucocarpum	B.o	B.o	
C. moluccanum	B.o	B.r	
Leptogium lacerum		B.o	
L. tremelloides	B.r		
Fam. Pannariaceae			
Coccocarpia cronia	R.o	R.o	R.o
C. gayana		B.o	
Pannaria immixta	B.o	B.o	
P. granulifera	B.o		
Parmeliella amphibola	B.o	B.o	
P. nigrocincta	B.f	B.o	
P. pyncnophora	B.o		
Psoroma arthrophyllum	B.o.		
P. buchanani		S.o	S.f
P. euphyllum	B.o.		
P. hirsutulum	S.f		S.f
P. leprolomum	B.o		
P. pholidotoides	B.o	B.o	
P. soccatum	B.o		
P. sphinctrinum	B.o	B.o	
P. xanthomelanum	B.o		
Fam. Stictaceae			
Lobaria laetivirens		S.r	S.o
Sticta aurata		S.o	S.o
S. billardierii	B.f		
S. cinnamomea	B.o		
S. coriacea	B.f		
S. coronata	B.f		
S. filix	M.B.f		
S. fragillima	B.o	B.o	
S. freycinetyii	B.o	B.o	
S. glabra	B.f		
S. hirta	B.f		
S. homeophylla	B.o		
S. impressa	B.f	B.o	
S. latifrons	B.f		
S. mougeotiana		B.o	
S. rubella	B.o		
S. subcaperata	B.o		
Fam. Peltigeraceae			
Nephroma australe var. australe		B.o	
N. helveticum var. helveticum		B.o	
Peltigera canina var. canina	S.r	S.r	
P. canina var. spuria	S.r	S r	
P. polydactyla var. polydactyla	S.M.r	S.M.r	
P. dolichorhiza var. dolichorhiza	S.M.r	S.M.r	
Fam. Lecideaceae			
Catillaria sp.		B.r	
Lecidea cinnabarina	B.r		
Lopadium fuscoluteum			S.o
Megalospora marginiflexa	B.o	B.o	
Psora spp.			R.o
Rhizocarpon geographicum agg.	R.o	R.f	R.f
R. grande		R.f	R.f
Fam. Baeomycetaceae			
Baeomyces absolutus	R.o		
B. fungoides	S.f		
B. heteromorphus	S.f		
Fam. Cladoniaceae			
Cladonia bacillaris		S.o	S.o
C. caressensis		S.f	S.f
C. cervicornis	S.o		S.o
C. chlorophaea	M.S.o	S.o	
C. coccifera	M.S.o		
C. cornutoradiata	S.o	S.o	
C. crispata		S.f	S.f
C. deformis	S.M.o		
C. fimbriata	S.o		
C. gracilis	S.M.f	S.f	
C. hypoxantha	S.M.o		
C. lepidota		S.o	S.o
C. macilenta		S.o	S.o
C. pityrea	S.M.o	S.o	S.o
C. pyxidata	S.M.o	S.o	S.o
C. scabriuscula	S.M.f	S.f	S.f
C. verticillata	S.M.o	S.o	S.o
Fam. Clathrinaceae			
Cladia aggregata	S.M.o	S.M.o	
Fam. Stereocaulaceae			
Stereocaulon caespitosum		R.f	R.f
S. colensoi	S.f		
S. corticatulum	S.f		
S. gregarium		R.f	R.f
S. ramulosum	S.f	S.f	
S. ramulosum var. macrocarpum	S.f		
Fam. Umbilicariaceae			
Umbilicaria polyphylla			R.f
U. pustulata			R.o
U. vellea			R.o
Fam. Pertusariaceae			
Coccotrema cucurbitula	B.o		
Pertusaria dactylina			S.f
P. graphica		R.f	R.f
P. nothofagi	B.o		
P. superba	R.r		
Fam. Lecanoraceae			
Candelariella vitellina		R.r	R.r
Haematomma babingtoni		B.o	
H. puniceum		B.o	
Lecanora atra	B.R.o		
L. blanda		R.o	R.o
L. parmelina			S.f
Myxodictyon chrisostrictum	B.o		
Ochrolechia parella		R.o	R.o
O. thelotremoides		R.r	R.r
Placopsis gelida	R.o	R.f	R.f
P. parellina	R.o	R.f	R.f
P. perrugosa	R.o	R.f	R.f
P. rhodopthalma		R.o	R.o

P. trachyderma (Kremp.) James	R.o	R.o	R.o
P. trachyderma var. *clavifera* (Lamb) James	S.R.o	S.R.o	S.R.o
Fam. Parmeliaceae			
Anzia angustata	B.o		
Hypogymnia enteromorpha	S.M.o	S.o	S.o
H. lugubris		S.f	S.f
Menegazzia circumsorediata	B.f		
M. fiordense Sant.	B.o		
M. pertransita (Stirt.) Sant.	B.f		
Parmelia adpicta		R.f	R.f
P. alpicola		R.f	R.f
P. caperata	R.B.o		
P. conspersa	R.B.o		
P. laevigata	B.o		
P. perlata	B.o		R.o
P. sulcata	R.B.o		
P. tiliacea	N.o		
Fam. Usneaceae			
Alectoria miniscula			R.o
A. pubescens			R.o
Neuropogon acromelanus			R.o
N. ciliatus			R.f
Usnea capillacea	B.f		
U. cillifera	B.f		
U. contexta			S.f
U. xanthopoga	B.f		
Fam. Buelliaceae			
Buellia canescens		R.o	R.o
Buellia spp. (grey)		R.o	R.o
Rinodina thiomela		R.o	R.o

DISCUSSION

The lichen flora of this region falls into four well-defined types of habitat:—

(1) Beech forest surrounding Lake Mackenzie. This contains two different lichen communities, one characteristic of the interior of the forest and the other present on the forest margin where there is plenty of light.

(2) Alpine snow-tussock slopes between timber line and exposed rocky summit ridges.

(3) Exposed rock on the high ridges and summit of Ocean Peak.

(4) Rock debris in the upper basin of Lake Mackenzie, from Emily Pass to the lake inlet.

(1) The lichen flora of the bech forest is similar to that reported by James from the Lake Thomson area of Fiordland (Mark *et al*, 1964); the greatest density of lichen species being found at or near the forest margin where greatly decreased shading from the forest canopy permits growth of fruticose, foliose and crustose forms. In the interior of the forest lichens are much less abundant, and are confined to a few shade-tolerant species, particularly of the genera *Sticta*, *Psoroma*, *Peltigera*, and *Collema*. Lichens appear to be excluded from some habitats by taster-growing bryophytes, but it is probably illumination that is the most important factor controlling the distribution of lichens in forest, many species tending to grow on those parts of the tree affording reasonable exposure to light, especially the crown.

The only lichens (with Chlorophycean phycobionts) that can tolerate low light intensity are those with a foliose thallus. Since the growth of any lichen is directly dependent on the photosynthetic products of the phycobiont, in any situation where light is the limiting factor for growth the more photosynthetic area available the greater seems the lichen's chance of survival. Moreover, the phycobionts of *Sticta* and *Psoroma* (genera frequently found in shaded positions in beech forest) are distributed in the lichen thallus in a more or less continuous algal zone immediately below a thin fungal cortex on the upper surface. This arrangement enables much of the light which falls on the thallus to be used by the phycobiont in photosythesis. Reinke (1895) pointed out that in fruticose lichens elongation of their thalline tissue into a dendroid form gives a greater area for photosynthesis and that this is advantageous in well-lit situations. This may explain the scarcity of fruticose lichens in forest interiors in New Zealand and their abundance on forest margins. Scott *et al.* (1964) observed that at altitudes of 450 m. and above in Fiordland forest the epiphytic moss *Weymouthia* is replaced by *Usnea* spp. At the altitude of Lake Mackenzie, 800 m., *Usnea* is a very obvious feature of well-lit situations, either at the top of the canopy where it is conspicuous even from a great distance, or near the forest margin.

James (in Mark *et al.* 1964) observed that in areas of low light intensity one of the most noticeable features of the lichen flora is a preponderance of species with blue-green phycobionts. Such lichens presumably achieve their success in colonization of habitats with low light intensity less by efficient use of light than by the greater biochemical versatility of their phycobionts. Non-symbiotic nitrogen fixation is well-established for blue-green algae. Henriksson (1951, 1957, 1961) has demonstrated that bacteria-free phycobionts of *Collema tenax* are capable of fixing atmos-

pheric nitrogen and of excreting polysaccharides, proteins and vitamins into the growth medium. These excretory products of the phycobiont partially satisfy the nutritional requirements of the *Collema* mycobiont. Lhotsky (1946) and Scott (1956) also demonstrated nitrogen fixation in symbiotic Cyanophyceae. The products of photosynthesis and nitrogen fixation of symbiotic blue-green phycobionts may improve the chances of survival of lichens having them.

(2) Snow-tussock slopes above forest are the habitat of many lichen species. In this locality species of *Siphula* are common. The most widespread is *S. medioxima;* the pinkish-white *S. fragilis* and *S. roccellaeformis* are common in damper areas, often in association with mosses. The short, sometimes almost bullate, thallus of this genus allows it to colonize areas exposed to wind and frost. It is markedly more successful than species of *Cladonia* in colonizing bare ground in many alpine localities in New Zealand. Murray (1963) records that *Siphula medioxima* is the most common lichen in tussock grassland on Secretary Island, Fiordland.

(3) On the exposed rock ridges of Ocean Peak the effect of wind is noticeable in the distribution of fruticose and crustaceous lichens. Above 1,500 m. sheltered sides of rock faces are well covered with a mixed community of lichens. commonly *Neuropogon, Usnea* and *Umbilicaria,* with *Usnea contexta* and *Hypogymnia lugubris* frequent on soil between the rocks. There is a marked reduction in the numbers of these fruticose lichens on rock faces exposed to the prevailing wind. These faces are, however, well colonized by crustaceous species notably *Rhizocarpon geographicum* agg., *Rhizocarpon grande* and *Pertusaria* spp. The lichen association, characterised by *Alectoria nigricans, Cornicularia aculeata, Cetraria islandica* var. *tenuifolia* and *Solorina crocea,* which is such a consistent feature of mountain ranges of similar altitudes east of the Main Divide and particularly of Central Otago, is remarkable by its absence from this locality.

(4) The cirque and boulder-strewn basin below Emily Pass is comparatively poor in lichens. Fruticose forms are almost entirely absent except for *Stereocaulon caespitosum* which is not uncommon on large boulders in sheltered situations. Species of *Placopsis* are the most common lichens of this habitat, copiously covering the most stable rocks. Strong winds and frequent persistence of frozen snow probably account for the great predominance of such crustaceous species and could prevent growth of fruticose lichens in such surroundings.

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